COPERNICUS & ME

Supporting access to electricity in Sierra Leone

▶ DECISION-MAKERS IN LOW- AND MIDDLE-INCOME COUNTRIES OFTEN LACK INFORMATION TO PLAN ELECTRIFICATION IN RURAL AREAS.

WITH SENTINEL-1 AND SENTINEL-2 IMAGERY IT IS POSSIBLE TO VISUALISE SUCH INFORMATION ON MAPS.

THANKS TO THE SATELLITE-BASED MAPS, GOVERNMENTS CAN TAKE INFORMED DECISIONS TO CARRY OUT THE ELECTRIFICATION PROCESS.

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GLOBALLY, MORE THAN 1 BILLION PEOPLE DON'T HAVE ACCESS TO MODERN ENERGY.

Most of them live in South Asia and Africa, in rural areas.

Lack of knowledge on dispersed populations and insufficient infrastructure and energy coverage are among the main factors discouraging investments in rural areas [1].

Despite the ambitious objective established by the Sustainable Development Goal 7 of "ensuring access to affordable, reliable, sustainable and modern energy for all by 2030" [2], progress towards electrification is still insufficient to allow for social and economic growth in rural areas in low- and middle-income countries.

AN IMPORTANT OBSTACLE IN THE ACHIEVEMENT OF SDG 7 IS THE LACK OF ACCESS TO THE RIGHT INFORMATION FOR DECISION-MAKERS IN CHARGE OF PLANNING ELECTRIFICATION IN RURAL AREAS.

Indeed, planners and companies working in remote villages lack information for decisions, and the same applies to investors.

In particular, off-grid energy planners need to understand where to extend the energy grid and where to prioritise off-grid markets for mini-grids and solar-home systems.

Moreover, they need information that will enable them to prepare tender processes, monitor electrification progress and provide adjusted subsidies.

Typically, existing datasets are scattered in different formats and locations and are not ready for use.

Moreover, on-ground teams cannot access strategic data and cannot report their data to decision-makers in a structured manner.

Indeed, until recently, the only way to find out more about such remote areas (i.e., energy demand, location, distance from the grids), was to send survey teams there. That is a manual process, is expensive, slow, and often inaccurate.

Sierra Leone is one of the world's poorest countries [3], where less than a quarter of the population has today access to modern energy.

ONLY 23% OF SIERRA LEONEAN HAVE ACCESS TO ELECTRICITY, WHICH IS BELOW THE SUB-SAHARAN AVERAGE OF 30%.

This hinders modern education and healthcare, job creation, competitiveness, and poverty reduction.

Indeed, energy is necessary to improve the performance of all economic sectors in the country, primarily agriculture, irrigation, cooling and food processing, and their resilience to climate change.

In January 2021, the World Bank approved a $50 million grant from the International Development Association (IDA) to improve access to electricity in Sierra Leone and enhance institutional capacity and commercial management of the sector [4].

The "Enhancing Sierra Leone Energy Access" project aims at helping the country's economic recovery after the COVID-19 pandemic by providing access to low-cost electricity to households, businesses, health clinics and schools, for a total of approximately 276,000 people and about 700 health facilities [5].

ONE OF THE TOOLS CHOSEN TO SUPPORT THE ELECTRIFICATION PROCESS IS VILLAGE DATA ANALYTICS (VIDA).

VILLAGE DATA ANALYTICS (VIDA)

Type of organisation: SME
Country: Germany
Annual budget in 2020: €500k - €1m
Previous experience with Earth Observation data: No

VIDA, A SOFTWARE BASED ON COPERNICUS DATA, CAN SUPPORT ELECTRIFICATION IN REMOTE AREAS.

Village Data Analytics, or VIDA, has been created by Tobias Engelmeier and Sebastian Wagner.

Both based in Munich (Germany), Tobias and Sebastian decided to join forces to develop a tool facilitating electrification in rural areas.

On this journey, they were supported by the European Space Agency and the PARSEC accelerator.

VIDA IS A MACHINE LEARNING-BASED SOFTWARE THAT ANALYSES SATELLITE IMAGERY, PUBLICLY AVAILABLE GEOSPATIAL DATA, ON-GROUND SURVEY DATA, AND ENERGY MODELLING, TO IDENTIFY AND CHARACTERISE RURAL VILLAGES, AND TO ASSESS THEIR SUITABILITY FOR OFF-GRID ELECTRIFICATION, INCLUDING MINI-GRIDS AD OFF-GRID STANDALONE SYSTEMS.

VIDA USES SENTINEL-1 AND SENTINEL-2 IMAGERY, AS WELL AS LAYERS DERIVED FROM VERY HIGH-RESOLUTION IMAGERY [6].

The software aims at yielding information and management tools to governments, development organisations, investors, banks, companies, and NGOs on off-the-grid communities in remote areas.

The Copernicus satellites provide VIDA with radar, visible and near-infrared satellite imagery.

In addition, VIDA exploits products derived from nightlight and very high-resolution imagery, publicly available GIS data such as Open Street Map (OSM) road data, Humanitarian Open Street Map's household data layers, and other available GIS/statistical data [7].

STEP 1: IDENTIFICATION OF VILLAGES

VIDA uses machine learning algorithms to identify remote villages in a user-selected area using satellite imagery.

STEP 2: EXTRACTION OF VILLAGE SELECTION FACTORS

For every identified village, VIDA automatically extracts village characteristics belonging to categories such as demographics, road and grid access, water and vegetation.

STEP 3: PREDICTION OF SOCIO-ECONOMIC HEALTH

A machine learning algorithm predicts the socio-economic health and off-grid viability factors for every village based on the extracted characteristics.

STEP 4: RANKING OF VILLAGES FOR MINI-GRID SUITABILITY

Based on the extracted village characteristics and predicted socio-economic health, VIDA scores every village. Villages in the selected geography are ranked based on this score.

Identify → Extract → Predict → Rank

The four-step methodology of VIDA's data analysis workflow. Source: TFE Energy GmbH, Improved Mini-grid selection in West Africa using Village Data Analytics (VIDA).

Earth observation imagery is analysed by VIDA to obtain standardised data about villages at the individual household level, such as their position, their distance from the energy grid, the presence of roads and infrastructure, of cultivated fields, and the environmental features of the surrounding areas.

The Earth Observation imagery is analysed through automated imagery recognition algorithms, and the data obtained are coupled with ground data on villages' demographic, topographic, agricultural, and socio-economic features that are obtained from customers, existing databases, and surveys.

THE RESULTING INTERACTIVE MAP ALLOWS USERS TO PICK RELEVANT INFORMATION FROM LARGE AMOUNTS OF DATA THAT CAN EFFECTIVELY SUPPORT DECISION-MAKING PROCESSES AT THE LOCAL LEVEL.

VIDA's customers typically receive relevant information in the form of rankings of villages with socio-economic predictions to prioritise efforts, and can also integrate their own data. Indeed, the user interface can be adjusted to the needs and requirements of users and is also available on mobile devices.

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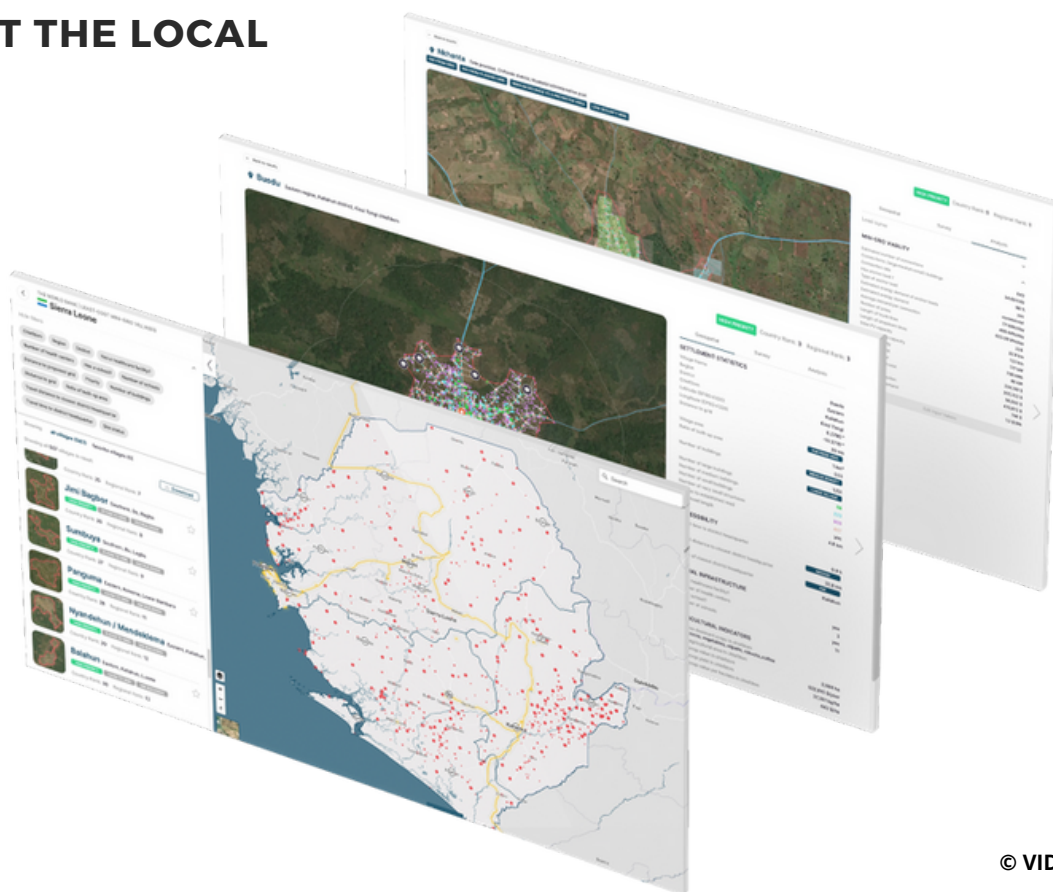
In the case of Sierra Leone, the area of interest is the whole Country's territory. The software identifies and lists all the villages in the area.

Through the user interface, the Government can unlock village-level information and add its own data.

The villages can be filtered according to different parameters, such as their region and district, the number of buildings, the presence and number of healthcare facilities and schools, their distance from the energy grid, and their priority level for the electrification process.

The software also allows users to annotate, upload, download and share information, and to integrate the data with other software.

SATELLITE IMAGERY CAN BE USED FOR DATA-BASED DECISION-MAKING IN REMOTE AREAS.

As a platform, VIDA processes regularly-updated EO and on-ground data.

Indeed, the rapidly expanding scale and update frequency of satellite imagery, as well as the fast pace of machine learning techniques, allow VIDA to characterise villages spread across the whole country and to monitor each village over time.

The VIDA interface over the town of Tihun, in the Southern Province of Sierra Leone.

In Sierra Leone, more than 500 villages were analysed with VIDA.

The software delivered a long list of villages suitable for mini-grid development that could be presented to stakeholders.

The settlements are sorted according to building connection count and settlement density, grid proximity, and infrastructure data, such as road access, proximity to a school or a hospital.

THE USE OF THE VIDA SOFTWARE AND ANALYSIS HELPED UNLOCK A $200M CREDIT FOR ELECTRIFICATION AND WILL CONTRIBUTE TO THE ELECTRIFICATION OF OVER 500 NEW MINI GRIDS IN THE COUNTRY.

"The Government of Sierra Leone can now accurately position the electricity grid and the villages, estimate their energy demand, and decide on how to best electrify them". Tobias Engelmeier, founder of VIDA.

This is crucial information for the government to create a transparent and data-based programme for electrification and to measure the effectiveness and impact of what they do.

Indeed, the government is now able to target electrification efforts on the basis of accurate, reliable information, to develop result-based subsidy programmes, and to monitor their impacts.

Data are provided fast, reliably and at-scale.

By integrating socio-economic data, VIDA makes the energy needs of remote villages visible to planners, companies and investors, thus acting as a catalyst for sustainable development.

The software is automated and globally available at village-level.

Until the Summer of 2021, VIDA was used to monitor more than 5.000 villages in 10 countries, helping to channel approximately 1.5 billion US dollars into remote electrification.

Through solutions like VIDA, governments can access the digital infrastructure needed to build the physical infrastructure.

Data, including satellite-based data, can be used to plan mini-grid systems and perform feasibility studies on these systems to predict their viability [8].

The site selection based on data analytics and satellite imagery creates a ranked shortlist of promising villages within an area of interest and reduces the number of on-ground surveys needed.

Overall, VIDA allows between 25-50% savings in the cost of man-hours needed to select the sites suitable for electrification, reducing the time to find a site by 67% and site-visit times by 80% through better scheduling [7].

WITHOUT ELECTRIFICATION, MORE THAN 1 BILLION PEOPLE IN SOME OF THE WORLD'S POOREST REGIONS WOULD FIND IT EXTREMELY DIFFICULT TO RESPOND TO THE CHALLENGE OF CLIMATE CHANGE, AND TO BUILD PROSPEROUS, MODERN LIVES.

LINKS

Village Data Analytics: www.villagedata.io
AppliedAI website: www.appliedai.de
Sustainable Development Goal number 7:
sdgs.un.org/goals/goal7
European Space Agency: www.esa.int
PARSEC accelerator: parsec-accelerator.eu
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Video, VIDA - Interview with Tobias - Summer of
Purpose 2021: www.youtube.com/watch?v=2kFl0O-
HtkM
Video, Village Data Analytics (VIDA) by TFE Energy:
www.youtube.com/watch?v=bNBqcLFMI0c&t=3s
Video, VIDA for Sierra Leone: www.youtube.com/watch?
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PARSEC Accelerator selects 15 winners at the PARSEC
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